The Weekly Cycle of Work and Rest

4 The weekly cycle of work and rest

A diary study

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Time is an inherent aspect of any human activity, in work as well as leisure. All activities draw upon the same energetic resources. The degree to which they do so depends on the demands and the amount of effort they require. The duration and frequency of the activities also plays a role: the more time people spend on executing given work tasks, the greater will be the depletion of their resources and the higher their experience of fatigue. The same holds for non-work related activities, such as traveling and performing household duties. More time spent on such activities will take energy and raise fatigue. Some activities, however, particularly relaxed leisure and sound sleep, are known to have the opposite effect. The time people spend on these activities translates into replenishment of resources. The processes involved in energy expenditure and recovery are complex and only partially understood. We know as yet little about how people seek and maintain a balance between these opposite processes. The aim of this chapter is to make a contribution to the clarification of this issue by studying how people distribute their effort and recovery over time, in particular over the days of the working week. It looks into the cycle of work and rest, and the influence of leisure activities and quality of sleep.

We designed a research project to gain insight in the cycle of work and rest during a regular working week. Respondents' daily engagement in various activities was studied with a diary technique, in which the daily fluctuations between levels of fatigue can be captured. Time is an important aspect in these studies; how time is used determines the effects in terms of level of fatigue. Therefore, it is important to note how time is spent and to see the changes over time in fatigue. Daily diary studies are ideal for tracking psychological phenomena over time (Harris, Daniels & Briner 2003) and capture data closer to the actual changes in fatigue levels, therefore making the data more reliable and less likely to suffer from recall effects associated with retrospective measurements.

Background and hypotheses

Work plays a very prominent role in the life of most people between eighteen and sixty-five years of age. The way in which people are affected by their work depends to large degree on their working hours. The scheduled working hours

provide structure to the workday, specifying when people have to be at the workplace and when they are expected to spend energy on their tasks. The working hours also determine what time is left for other activities, such as travel, household, caring activities, other family activities and leisure. It can be said that working hours are an important determinant of the cycle of work and rest. Working hours synchronize peoples' presence and therefore facilitate any form of organizing. One of the consequences of the increasing regulation of working hours by employers was that people could no longer decide for themselves when they would start and/or finish working, or take a break. Hence the time *after* work was the time that people had to rest and recover from work.

We can think about the working day as consisting of three separate blocks of time, each related to different life spheres: (1) time for work and traveling to work, (2) non-work time, or time after work, and (3) time for sleep. The way our society is currently organized implies that when we are 'at work' we have to work; and the time after work is meant for resting and recovering from the daily hassles. However, non-work time can be further divided into time that needs to be devoted to activities such as domestic chores and other unavoidable activities, and leisure activities. It is assumed that the various activities after work – i.e. domestic duties, (child) care, social activities, sports and so on – also impose demands on our resources. Consequently, not all after-work time is available for the recovery process.

Intuitively, it is clear that people need to recover after a period of work, and that rest or change of activity helps with recuperation from fatigue. Fatigue and recovery are related concepts: fatigue is the (reversible) state that results from having been active, either physically or mentally, for some length of time. Recovery is the process of replenishing the depleted resources. Although this can be seen as primarily a physiological process of restoring a homeostasis within the organism (McEwen 1998; Meijman & Zijlstra 2007), it has clear psychological aspects as well. Fatigue has a motivational component: when people are tired, they lose their motivation to continue with that particular activity. Recovery should lead to a reduction of fatigue and allow people to continue for somewhat longer with their activity. In the absence of a good parameter for recovery, we use (reduction of) fatigue as an indicator (or proxy) for the recovery process.

Lack of opportunities for recovery is sometimes seen as a major source of reduced well-being (i.e., fatigue, stress). Sonnentag and Zijlstra (2006) show that there is a relation between people's activities during the day and during after-work time, and that the (temporary) absence of demands being imposed upon the person is essential for the recovery process. Various societal developments have affected the organization of work. Increased use of information technology, globalization of the economy, and the call for flexibility at work have had a noticeable effect on how work is organized, and are believed to affect the time available for recovery. For instance, with the help of ICT people can work anywhere they like at all times; as a result many people tend to take work home, or engage in work or work-related activities after work hours. Thus they

extend their working day, implying that the longer the working hours or the more time spent on work or work-related activities, the less opportunity for recovery from the daily strains. *Therefore, we hypothesize that the amount of time spent on work (including commuting to and from work) will have a negative effect on recovery, and thus lead to higher levels of fatigue* (Hypothesis 1). Further, since people usually undertake some activities after work, either activities undertaken out of free will (leisure type of activities) or activities of an obligatory nature (household chores; social obligations; work-related activities), *we expect that activities that presumably require a high level of activation (i.e., work-related activities and household activities) will be positively associated with fatigue (and thus recovery inhibitive)* (Hypothesis 2).

Recent studies show that a failure to unwind during the evening (after work) leads to sleeping problems (Akerstedt, Knutsson, Westerholm, Theorell, Alfredsson & Kecklund 2002) and feeling not refreshed the next morning (Meijman, Mulder & Van Dormolen 1992; Sluiter, Van der Beek & Frings-Dresen 1999). Failure to unwind is often associated with being very active in the preceding periods; this activity can refer to either working late or engaging in physical sports – in other words, physical or mental activities. Many people also report sleeping problems because they worry about their work (Cropley, Dijk & Stanley 2006); thus, sleep is important but, according to Craig and Cooper (1992), sleep quality is more important than sleep quantity (= time for sleep). Therefore, a third hypothesis is that *peoples' ratings of sleep quality will be negatively related to fatigue* (Hypothesis 3).

Normally, people spend less time at work or work-related activities during the weekend. Therefore we expect that there will be an opportunity for recovery during the weekend. So, levels of fatigue should drop significantly over the weekend, and sleep quality should increase. Thus our fourth hypothesis is: *Fatigue scores will be higher during the week than during the weekend* (Hypothesis 4).

Method

Study design

Diaries were used to obtain data over a seven-day period, typical of a normal working week and weekend respite. Respondents logged the time they went to work and came home again, and also the amount of time spent engaged in specific activities during non-work time, whilst recording sleep patterns and completing a daily fatigue questionnaire. Respondents started filling out the diaries on the Sunday, running through to the following Sunday to obtain a full week's scores.

Participants

A sample of the working-age population was recruited from three different organizations: 39 percent from a petroleum company, 46 percent from an IT

company and 15 percent from an opportunity sample. An Occupational Health fair provided a recruitment opportunity whereby appreciation of a 'diary' could be supplemented by verbal instruction. Additional to verbal instruction during recruitment (to obtain informed consent and provide assurances of anonymity), clear and comprehensive instructions were given along with the diaries. Initially 109 individuals were approached for participation; a 42 percent response rate put the final sample at $n=46$, with eighteen men (39 percent) and twenty-eight women (61 percent), the mean age of respondents was 34.93 years (range = 40, SD = 11). Their occupational roles varied: there were thirteen respondents in technical and information technology roles, ten were managers and another ten administrators, while five were academics, four customer services and support workers, two directors and two health professionals. The majority of respondents were single or living with a partner (59 percent single; 41 percent married); 59 percent had no children, 6.5 had one child, 24 percent had two children, nine had three children and 2 percent had four children. There were no significant differences between the average weekly hours worked by males and females in the current sample in comparison to national averages (Office for National Statistics 1998): (males: $t_{(17)} = -0.88$; $p > 0.05$ (two-tailed), females: $t_{(27)} = -1.87$; $p > 0.05$ (two-tailed)).

Measures

After-work activities

Respondents were provided with a table for each day containing a list of five prototypical activities (based on Sonnentag 2001) for after-work time activities; these include: *Work-related tasks* (e.g., responding to work e-mail), *Household tasks* (e.g., cooking, cleaning, looking after children), *Low-effort tasks* that are not demanding (e.g., listening to music), *Physical activities* (e.g., playing sport) and *Social activities* (e.g., visiting friends). Respondents logged the amount of time spent on each activity category per day (in minutes).

Fatigue

A measure of fatigue was used as a proxy of recovery; fatigue was assessed daily using the Checklist Individual Strength [CIS-20R] (Vercoulen *et al.* 1994), a twenty-item self-report instrument measuring four aspects of fatigue: the *Subjective feeling* of fatigue (eight items, $\alpha = 0.86$), *Concentration* (five items, $\alpha = 0.92$), *Motivation* (four items, $\alpha = 0.76$) and *Physical Activity* (three items, $\alpha = 0.80$). Items were rated on a seven-point scale (1 = *Yes, that is true*; 7 = *No, that is not true*). Subscales were scored to produce a composite ranging from twenty to 140 (total CIS $\alpha = 0.83$), higher scores indicating a greater level of fatigue, more concentration problems, reduced motivation and less activity. Although epidemiological studies utilize pre-defined cut-off points to define fatigued cases, fatigue is best studied along a continuum (Bültmann 2002); therefore

higher scores are conceptualized as a lesser degree of recovery and vice versa. Respondents completed the CIS thirty minutes before retiring to allow for the ameliorating or inhibitive effects of intervening activity. The CIS questions individuals about fatigue during the past two weeks, but the instruction was changed by the authors for use in the present study to ask individuals to indicate how they felt during the preceding period (couple of hours). In this sense it was adapted to be a situational measure of fatigue. Items in the checklist remained the same. Internal consistency coefficients indicated reliability of the measure.

Sleep and sleep quality

Respondents kept a sleep diary (adapted from Morin 1993), answering eight questions in the morning before leaving for work. This diary provided the following relevant parameters. *Total sleep time [TST]*, calculated from sleep onset latencies, and time in bed *[TIB]* allowed calculation of a *sleep efficiency index [SEI; %]*, a ratio of TST and TIB. Two items allowed respondents to rate sleep quality *[SQ]* and feeling upon arising *[FUA]*: 'When I got up this morning I felt' 1 = *Exhausted*, 5 = *Very refreshed* and 'Overall, my sleep last night was' 1 = *Very restless*, 5 = *Very sound* ($\alpha = 0.86$). Previous empirical research validated the use of subjective measures of sleep and sleep quality (e.g., Killen, George, Marchini, Silverman & Thoresen 1982), which often correlate well with objective measures (see, for example, Johns & Dore 1978).

Work characteristics

Respondents reported the amount of time spent (hours and minutes) on contractual work and traveling to and from work. Job characteristics were assessed using a ten-item questionnaire derived from Karasek's (1979) model (adapted by Cropley, Steptoe and Joekes 1999): three dimensions were assessed: *perceived demand* (three items), *job control* (three items) and *skill utilization* (four items), rated on a four-point scale where 1 = *Strongly disagree*, 4 = *Strongly agree*.

Data analysis

Data were analyzed using SPSS 11.0. Continuous time data were calculated for each respondent both at the day level and averaged across the total working week; thus for the proxy of fatigue, individual scores existed for each day of the week, in addition to a summed and averaged total for the entire working week. Data were examined both at the week (averaging scores over the seven days) and day levels using t-tests and repeated measures of ANOVA; pair-wise comparisons were used to examine the significant differences in the major study variable scores for each day of the week. Zero-order correlations and regression analysis also enabled trends to be elucidated in addition to the predictor effects of work variables, recovery activities themselves and also sleep variables. Although a cases-to-Independent Variable's (IV) ratio of $n = 50 + 8m$ is

suggested to run multiple regressions (Tabachnick & Fidell 2001), the current sample size ($n=46$) is adequate following a minimum requirement of five times more cases than IVs (Coakes & Steed 2001). In addition to screening and replacement of missing values using mean substitution for a small amount of cases, no univariate outliers ($z>3.29$) were identified. Distribution of continuous variables, such as time data and fatigue, was found to be normal, with no significant skewness or kurtosis.

Results

Relationships between after-work activities and recovery

Table 4.1 shows the zero-order correlations between the major study variables.

To examine the specific contribution of leisure activities and the other main study variables to the experience of fatigue, a linear multiple regression was employed using fatigue as the dependent variable. First, however, a regression analysis was run to ascertain whether demographic information significantly predicts elevated levels of fatigue. In comparison to the constant-only model, the model with demographic information was not statistically significant ($F=0.83$, $p=0.53$), indicating that age, sex, marital status, presence of children and occupation, as a set, do not reliably distinguish between fatigued individuals. With regard to individual predictors, β statistics confirmed that none of the demographics reliably predicted fatigued status.

In the linear regression analysis, all predictors were entered into one model simultaneously to ascertain their specific contribution to the increase or decrease in fatigue scores. No multivariate outliers (>26.12) were identified using Mahalanobis distance $p<0.001$ criterion. Table 4.2 summarizes the results of the analysis. The model contained work hours and travel, recovery activities and sleep parameters. As a set, these predictors were significant $F_{(9,36)}=5.47$, $p<0.01$, accounting for 47 percent of the variance in fatigue levels.

Individual coefficients show that work and travel time did not significantly contribute to fatigue (i.e. Hypothesis 1 was not supported). Time spent on household activities was also not related to fatigue.

Time spent on physical activities is significantly associated with decreases in the experience of fatigue ($\beta=-0.39$, $t=-2.88$, $p<0.01$). However, low-effort and social activities were non-significantly associated with increases in fatigue (i.e. recovery inhibitive). Thus Hypothesis 2 received only partial support. Physical activity accounts for 9.67 percent of the variance in fatigue ($sr^2-0.276$).

Sleep quality and feeling upon arising emerged as significant predictors, associated with decreases in fatigue as subjective ratings increase ($\beta=-0.38$, $t=-2.55$, $p<0.05$), accounting for 7.62 percent ($sr^2-0.311$) of the unique variance in fatigue scores (supporting Hypothesis 3). None of the other major study variables that were entered into the equation significantly predicted fatigue. Thus, when people feel refreshed in the morning (after a good night's sleep) they are less tired in the evening before going to bed. Consequently, the reverse

Table 4.1 Zero-order correlations between the major study variables ($n = 46$)

	M	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	
1. Fatigue‡	479.52		113.71	–											
2. Work-related[a]	203.3	(3.4)	352.9	–0.05	–										
3. Household[a]	437.61	(7.3)	312.37	0.05	–0.04	–									
4. Low-effort[a]	885	(14.8)	514.81	0.32*	–0.14	0.12	–								
5. Physical[a]	335.33	(5.6)	284.37	–0.56**	0.14	–0.21	–0.11	–	–	–					
6. Social[a]	824.78	(13.8)	380.9	0.19	0.13	–0.16	0.21	13	–						
7. Work hrs	2,445	(40.75)	418.7	–0.13	0.03	0.04	0.27*	17	–0.10	–					
8. Travel	209.54	(3.5)	132.4	0.11	0.12	–0.11	–0.21	–0.05	–0.10	0.15	–				
9. Job strain	12.84		2.57	–0.37**	0.14	–0.18	–0.28*	0.07	–0.18	0.25	0.11	–			–
10. TST[b]	2,978	(49.6)	255.4	–0.08	–0.04	0.01	0.03	–0.00	–0.16	–0.22	–0.01	0.07	–	–	–
11. SEI[c]	87.25		5.06	–0.35**	0.11	0.02	–0.09	–0.09	–0.10	–0.10	0.15	0.19	0.53**	–	
12. SQ[d]	24.80		5.27	–0.62**	–0.11	–0.15	–0.16	0.35**	–0.09	0.04	–0.07	0.28*	0.26*	0.44**	–
13. FUA[e]	21.08		5.27	–0.49**	–0.09	–0.23	–0.22	0.44**	–0.27*	0.23	0.13	0.31*	0.24	0.31*	0.60**

Notes
‡ Composite fatigue score – summed CIS score over seven days.
a Means & Standard Deviations for time spent on activities over the seven day period in minutes (hours in parentheses).
b Total sleep time.
c Average sleep efficiency over seven days.
d Composite sleep quality, sum over seven days, treated as continuous variable – higher scores indicate better ratings of sleep quality.
e Feeling upon arising, sum over seven days, treated as continuous variable – higher scores indicate a more refreshed feeling when arising.
*$p < 0.05$; **$p < 0.01$ (one–tailed); Power = 0.90.

Table 4.2 Multiple regression analysis for variables predicting overall fatigue scores ($n = 46$)

Variable	β	t	R^2
Total time – Work-related	–0.012	–0.106	
Total time – Household	–0.100	–0.799	
Total time – Low-effort	0.157	1.351	
Total time – Physical	–0.385**	–2.875	
Total time – Social	0.137	1.128	
Sleep Quality + FUA	–0.380*	–2.546	
Average overall sleep efficiency	–0.191	–1.367	
Time for sleep	0.149	1.087	
Work + travel time	0.017	0.130	
			$R^2 = 0.58$ Adjusted $R^2 = 0.47$ $R = 0.76$

Notes
*$p < 0.05$; **$p < 0.01$

is also true: when they do not feel refreshed when they wake up, they are more tired in the evening, suggesting an accumulation of fatigue.

Cycle of recovery during the week

Figure 4.1 demonstrates the typical pattern of fatigue over the course of a working week. Levels of fatigue appear to be highest at the beginning of the week (Monday and Tuesday), with a sharp decline towards the end of the week and over the weekend – indeed, both the linear and quadratic trend evidenced in Figure 4.1 is significant (linear $F_{(1,45)} = 12.81$, $p = 0.001$, $MS_{fatigue} = 4260$; quadratic $F_{(1,45)} = 9.33$, $p = 0.004$, $MS_{fatigue} = 1623$). To test the significance of these differences in fatigue over the week, pair-wise comparisons revealed that there are significantly lower levels of fatigue on Sunday in comparison to all other six days of the week (mean difference = 12.50, $p < 0.01$). Fatigue levels on Wednesday are significantly higher in comparison to both days during the weekend (mean difference = 7.18, 13.47 respectively, $p < 0.05$). These results seem to be demonstrating the traditional function of a weekend 'respite'; additional support is found from paired-samples t-tests: fatigue during the week is significantly higher than fatigue over the weekend (Wed.: Sat., $t_{(45)} = 2.02$, $p = 0.04$ one-tailed. Wed.: Sun., $t_{(45)} = 4.22$, $p < 0.01$ one-tailed), thus supporting our fourth hypothesis. Correlations also suggest that higher fatigue during the weekend is associated with increased fatigue during the week (Wed.–Sun.: $r = 0.51$, $p = <0.01$ one-tailed; Mon.–Sun.: $r = 0.66$, $p = < 0.01$ one-tailed). The data suggest that lack of recovery during the weekend spills over into the working week (i.e., higher level of fatigue on Monday).

Interestingly, following previous research (e.g. Bültmann, Kant, Kasl, Beurskens & van den Brandt 2002a), 39 percent of participants in the present

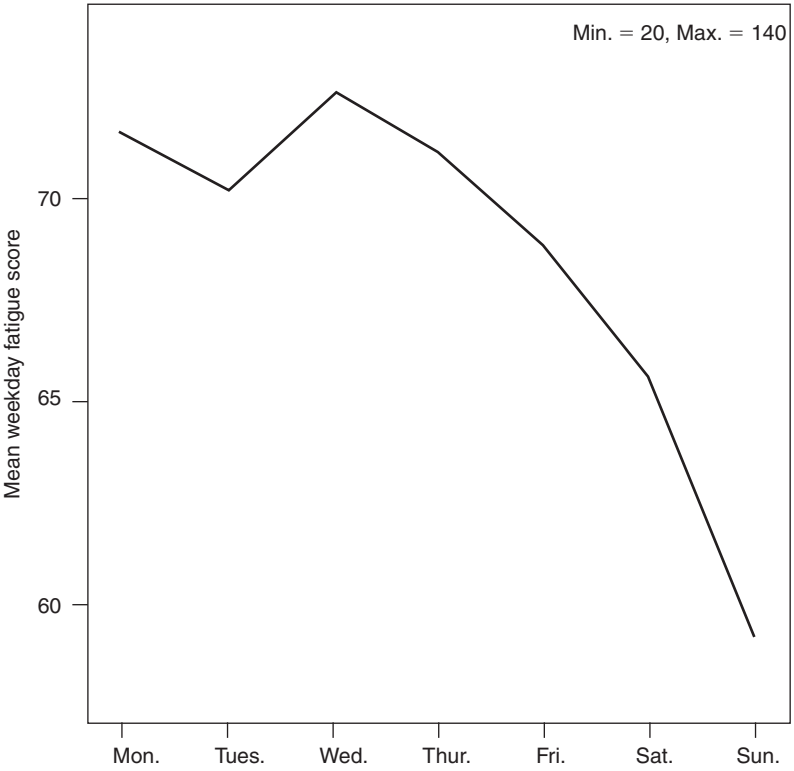

Figure 4.1 Pattern of recovery over the days of the week.

study would be considered at risk of sickness absence due to fatigue. This is utilizing a cut-off point of CIS20R > 76 whereby those individuals scoring above that score are at risk.

Effects of sleep on recovery

On average, respondents obtained just over seven hours sleep per night with an average sleep efficiency of 87 percent. Sleep time increases over the weekend, as does the level of sleep quality and feelings upon arising. Correlations in Table 4.1 suggest that sleep is beneficial to recovery (supporting Hypothesis 3). Figure 4.2 shows the changes to the levels of sleep quality over the course of the week; the highest levels are observed over the weekend, with the lowest ratings typically observed on Monday morning. Pair-wise comparisons from the repeated ANOVA measures showed that sleep quality ratings were significantly lower on Mondays, Tuesdays and Thursdays in comparison to Saturday sleep quality ratings (mean difference = –0.46, –0.45, –0.44 respectively, $p < 0.05$). These results support the trend of a weekend respite in the sleep data. The pair-wise

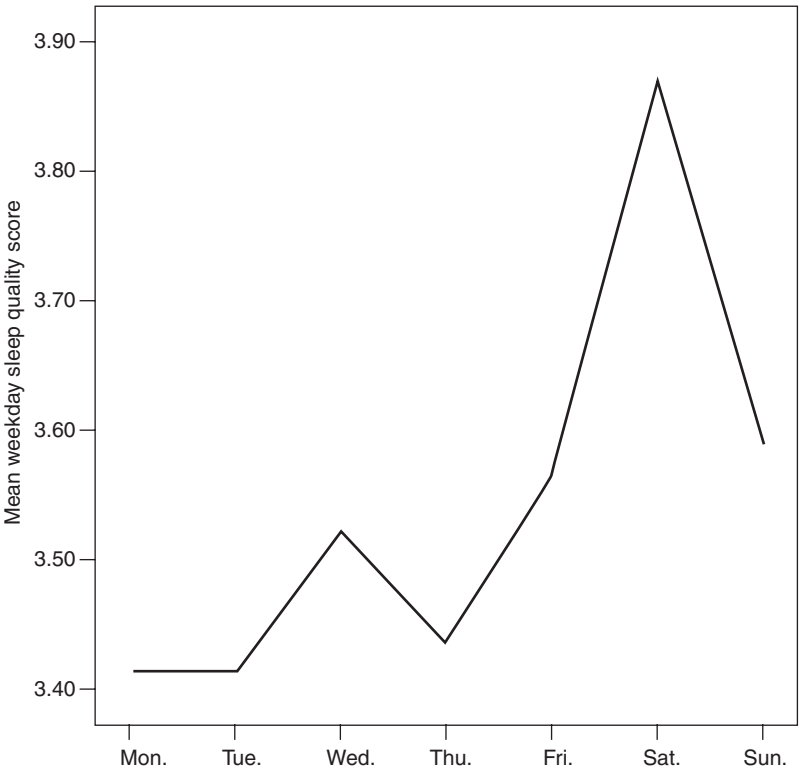

Figure 4.2 Pattern of sleep quality over the days of the week.

comparisons also revealed a significant linear trend towards feeling more refreshed upon arising at the weekends (linear $F_{(1,45)}=4.26$, $p=0.045$, $MS_{fatigue}=4.14$). Respondents reported significantly higher feelings upon arising (FUA means feeling refreshed) ratings on Saturday in comparison to all other working days (Mon.–Fri. mean difference = 0.58, $p<0.05$). We can interpret this as support for Hypothesis 4. As can be seen in Figure 4.2, the lowest sleep quality ratings appear on Monday. However, it should be noted that these ratings are obtained on Monday morning, and refer to the Sunday's sleep episode. This may seem counterintuitive, but could indicate the anticipation of work demands.

Work variables

No significant effects or differences were found for travel time (Mon.–Fri.), i.e. time for commuting from home to work. Respondents reported an average job strain of 12.84 (SD = 2.57), with 17.4 percent ($n=8$) of the sample scoring 10 or below (good balance between demand/control and low strain) and 82.6 percent ($n=38$) reporting higher strain in relation to their work. In comparison to

previous studies, however, the sample reported significantly lower job strain scores ($t_{(45)}=-7.8$, $p<0.01$, two-tailed); thus respondents are not in a statistical sense 'high strain'.

Discussion

The results of this study indicated that the amount of time spent on work and travel, and also the amount of time spent on work-related activities after work hours, did not contribute to predicting fatigue. Such a finding is consistent with some other studies that failed to find a direct association between number of hours worked and fatigue, in particular when people have a choice in deciding to work long hours (i.e. higher-level or white-collar jobs, as in this sample; see Josten 2002). People who spend a lot of time on their job usually do enjoy their work and thus do not experience fatigue. Also important is whether employees have autonomy within their job and can decide themselves when to take a short break. Regulating effort expenditure during work by adjusting the work pace and taking short breaks may help to reduce building up feelings of fatigue (internal recovery).

Contrary to predictions and recent findings (e.g., Sonnentag 2001), low-effort and social activities were not conducive to recovery after work. Low-effort activities were even associated with increases in fatigue. These activities are generally rather passive, and might not help to disengage from work activities. Their passive nature may even enhance feelings of fatigue, apathy and lethargy (see Iso-Ahola 1997). Low-effort activities may therefore be beneficial for recovery from physical fatigue rather than from psychological fatigue. On the other hand, it might be that people who feel fatigued find themselves too tired to engage in any activities other than those that are low effort, thus suggesting that low-effort activities are not conducive to recovery. This type of study (cross-sectional, self-report data) does not allow the drawing of causal inferences concerning the relationships between variables.

The results of this study suggest that the amount of time spent on various activities is perhaps not as important as the qualitative experience of the activities. What is important is whether these activities help people to switch their mind from the 'hassles at work' to other things. These results could also explain the lack of support for the second hypothesis. Household activities, in particular caring for children, require active involvement, and this helps one to disengage from the daily strains of work; therefore, they may even be seen as beneficial for recovery.

With regard to activities conducive for recovery, it was demonstrated that a greater time engaged in physical activity increased recovery levels, thus providing partial support for the second hypothesis; moreover, individuals with low levels of fatigue spent significantly more time engaged in physical activities. Although it was beyond the scope of the present research to isolate the precise mechanisms involved, such as the positive effects of endorphins (Steinberg *et al.* 1998), social support (Jones & Bright 2001) and general well-being (Iwasaki

2001), physical activity emerged as a strong individual factor benefiting recovery (with a large effect size); thus, our study is consistent with findings that lifestyles with low amounts of exercise results in more feelings of fatigue (e.g., Bültmann *et al.* 2002; Jette 1997).

In support of our third hypothesis, sleep appears to be crucial to daily recovery from strain, i.e. it is significantly negatively related to fatigue scores. It was discovered that the better participants felt immediately upon arising and the more positive the ratings of the sleep episode, the less likely they were to experience fatigue at the end of the workday. Extensive previous research has confirmed the importance of sleep with regard to maintaining optimal performance (Campbell 1992), preserving memory (Tilley & Brown 1992) and cerebral functions (Horne 2001; Jouvet 1999). Also in this study, sleep emerged as important to recovery. Analysis revealed that after accounting for work variables and intervening activities, it is sleep quality that predicts recovery by reducing the experience of fatigue, not the duration of a sleep episode, which is in line with previous findings that sleep quality can predict subjective sleepiness and mood states (such as vigor) better than simple sleep quantification (see, for example, Pilcher 2000). In the present findings, the subjective component of sleep (experience of sleep) emerges as more important than sleep quantity. Sleep quantity is important in maintaining sleep quality and therefore affecting recovery indirectly (cf. Horne 2001).

The present study confirms the importance of the traditional weekend respite, since a substantial amount of recovery occurred over Saturday and Sunday: individuals are significantly less fatigued, with parallel significant increases in sleep quality ratings and feelings upon arising. Indeed, the trend of a sharp decline in fatigue over the weekend was statistically significant. Saturday appeared to be a particularly beneficial day for recovery with regard to improved sleep – it seems entirely possible that this 'pinnacle day' for recovery carries recovery effects over into Sunday, hence explaining why fatigue levels are lowest on this day (i.e. highest levels of recovery). These beneficial effects are attributed to a period of 'time off' when the pressures of work are absent, thus allowing the organism to return to pre-stressor levels of functioning; evidently this level of recovery is not possible during the working week.

The lowest levels of recovery seen at the beginning of the week appear to contradict the respite effect, since fatigue may be expected to be lower immediately after 'time off'. Westman & Eden (1997) found that subsequent to a vacation, feelings of burnout were reduced, but returned towards pre-vacation levels within three days. In the present case we suggest that the same mechanisms (i.e. effort-recovery) operate over the weekend, yet since this respite is only two days and a vacation typically longer, this shorter duration accounts for a rapid return to highest stress (fatigue) levels. The weekend respite still operates but fades rapidly in the course of work schedules (Fritz & Sonnentag 2005; Strauss-Blasche, Muhry, Lehofer, Moser & Marktl 2004). Significantly, higher fatigue scores during the weekend are related to higher fatigue on Monday; the suggestion is that if individuals are not fully recovered over the weekend, there might

still be fatigue residuals on Monday. The result will be that extra effort will have to be exerted at the beginning of the successive week; the short-term load reaction of exerting this extra effort during Monday is shown by the higher fatigue scores on that evening. These results are indicative of the 'vicious cycle' described by previous authors, such as Meijman and Mulder (1998) and Sluiter *et al*. (1999). Tentatively, one could hypothesize that the long-term effects of insufficient recovery, such as chronic fatigue or burnout, might only manifest themselves after a long period of these cycles and poor short-term recovery. Future research would have to seek confirmation for these effects, but the trend has been elucidated.

It is interesting to note that sleep quality ratings on Monday were quite low. These ratings were obtained on Monday morning and reflect the Sunday's sleep episode, perhaps pointing in the direction of an anticipation of work demands. People start thinking of their work on Sunday evening, and start to worry, which subsequently affects their sleep quality. Indeed, our findings of anticipation of work demands are supported by medical research that has demonstrated a Monday morning surge in blood pressure that is associated with significant increases in deleterious cardiovascular events on that day, such as myocardial infarctions and strokes (Murakami *et al.* 2004). Thus, the recovery trends in our data are borne out by research that lends credence to the idea of a stressful change from weekend leisure activities to work activities on Monday that require mental and physical exertion. Individuals are reactivated on Mondays, in both a physiologic and a psychological sense.

Work variables of working time and travel time remained non-significant to aspects of recovery from fatigue. Although their trends are in line with the traditional working week and weekend respite, they exerted no significant effects on the outcome hypothesized variables in the study. Higher job strain was significantly negatively related to fatigue and time spent on low-effort activities: These findings seem strange in light of the established links between job strain and stress reactions (e.g., Jones & Bright 2001) and recent research demonstrating that job strain increases fatigue (Bültmann *et al*. 2002a). However, this anomaly is explicable in terms of 'eustress' (Selye 1976) and adaptive levels of 'high activity' (Schabraq, Cooper, Travers & van Maanen 2001). Individuals may agree with statements pertaining to demands in their work (i.e., 'the pace of work in my job is very intense'), yet not suffer short-term reactions. One imagines healthy workers doing a 'tough' day's work, with high levels of stress hormones circulating, yet during leisure time successfully returning to pre-stressor levels. If this were the case, they wouldn't report high levels of fatigue and could, conversely, report increases in recovery if they felt satisfied with the day's work or experienced 'positive pressure'. The finding that increased job strain is related to better sleep quality supports this theorizing. By enhancing self-esteem and producing satisfaction with achievement of goals (Furnham 1997), a 'hard' day at work (i.e., *active jobs*) need not result in negative reactions. Clearly, the long-term effects of job strain are unlikely to be detected by this 'snapshot' into recovery processes (e.g., cardiovascular disease; Karasek &

Theorell 1990). Since respondents were not 'statistically' high strain, our interpretation might be that these workers don't require low-effort recovery, thus explaining the absence of effect.

Limitations

Several methodological issues need to be accounted for when interpreting the results. The sample size is relatively small in comparison to previous diary studies, and therefore cannot be regarded as truly representative of the working population. Also, we have studied one working week only, and cannot guarantee that this week is representative for all work weeks throughout the year, although respondents indicated that this week was a normal week.

Control over when and where respondents completed sections of the diary remains problematic. It is impossible to conclude with any certainty whether respondents completed the sleep diaries shortly after arising, or whether the CIS was completed thirty minutes before retiring. Such issues present a challenge for future research: it is now possible to equip respondents with pagers or beepers to ensure regular responses and experimental intervals, or to consider the use of electronic diaries similar to those utilized in clinical trials. To move towards the use of such techniques would be a move towards the Experience Sampling Method [ESM], which would allow tighter control and a good method of studying the experience of recovery activities and the concurrent measurement of recovery variables using electronic equipment. Reactance is another problem with the validity of results, since keeping a diary could alter behavior, thoughts and feelings (Breakwell & Wood 2000); however, it has been suggested that leisure patterns are unlikely to be changed over such a short period (cf. Sonnentag 2001). Nevertheless, diary studies can be considered a useful method in this type of research.

Practical implications

Several applied aspects emerge from this research. First, it is suggested that individuals and organizations pay more attention to the issue of recovery outside the workplace; organizations seem reluctant to become involved in non-work life (O'Driscoll & Cooper 2002), but clearly non-work time is necessary for individual recovery, without which individual and organizational 'health' will suffer (Sonnentag 2001). Occupational health should not just include work and organizational conditions, but also work–life balance and the challenges people face outside of the work domain. Interventions based on the present results will depend upon readers' personal evaluations, but several recommendations could be made. One would be that engaging in activities that require active involvement helps one to disengage from work: such activities appear to be conducive to recovery, and thus employees should be stimulated to take a 'real' break at midday (lunch) and not spend their lunchtime behind their desk or in meetings. In particular, when work is primarily mentally demanding, physical activity

seems to be a core aspect of recovery (Donkin 2001). Individuals doing such work should maximize time spent on physical pursuits. Furthermore, employees should be stimulated to pursue their hobbies after work.

Second, the weekend is a period that organizations should 'preserve' in order to allow employees to recover; whilst this tradition is not overtly threatened in many societies, some countries' industrial relations reforms, such as Australia's, which have seen the phasing out of penalty rates for weekend and overtime work, hasten the decline of the weekend as it ceases to be differentiated from the week in employment terms. The increase in mobile technology and rapid communication devices means that individuals are more likely to engage the same psychological systems when not at work, or perhaps when 'recovering' (e.g., Zijlstra, Schalk & Roe 1996), and this means that whenever e-mails (or other messages) are sent after work hours (evening, weekend) there should not the expectation that the message will be read or a reply forwarded.

Direct intervention to improve sleep quality is also important – one possibility may be to ensure that work tasks or problems have received a degree of 'closure' prior to leaving the work setting, thus ensuring that individuals do not 'activate' themselves subsequently. Organizations might also consider paying particular attention to these issues on Mondays, particularly when recovery over the medium-term (and possibly long-term) will depend upon psychological states on this day.

Future research

It is recognized that the weekend respite is important in terms of recovery. However, to what extent is this threatened by the 24/7 society? An interesting question in this respect is, what mechanisms contribute to the recovery process? This raises the issue of whether a two-day respite would have the same effect for people working in shifts, and thus whether a 'collective' element (i.e. the traditional Saturday and Sunday) is important. These are questions that future research needs to address.

Conclusion

The results of the research reported in this chapter demonstrate that it is necessary to look at general lifestyle patterns (including leisure and sleep) in order to understand the effects of job stressors on peoples' health. Recovery from daily strain is determined by the work–rest cycle. Importantly, it is not the mere duration of an activity but rather the subjective experience (the quality) of a particular activity that constitutes the recovering effect.

Only through replications will psychologists arrive at a more precise understanding of what constitutes successful recovery on the fatigue continuum. Replications with a larger sample are strongly recommended, which could help to elucidate cut-points for recovery – i.e. scores that represent successful recovery. Perhaps what emerges is that stress and our adaptation to it (i.e. fatigue) is an indi-

vidual process. Individuals need to discover their own thresholds and live at a pace of life suited to their needs: for Selye (1976: 413), 'Activity and rest must be judiciously balanced, and every person has his own characteristic requirements for rest and activity'. Some individuals may maintain health and avoid deleterious outcomes by taking regular short breaks or holidays (Cartwright & Cooper 1997), whilst others may require episodes of recovery on a daily basis involving physical activity. If individuals recognize that a bout of physical activity prepares them for rest and sleep or, conversely, that they become 'activated' and fatigued by completing work tasks, they should adopt strategies or reach compromises with employers to enable them to achieve a personal balance.

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